# GAS CIRCUIT, CYL, $O_2$-He INSTALLATION FOR NARKOMED ANESTHESIA SYSTEMS

## INSTALLATION PROCEDURE

NOTE: Refer to Drawing No. S010099 for kit information.

1. Turn the System Power switch to ON and disconnect all pipeline hoses.

2. Close all cylinder valves except the $O_2$ cylinder valve.

3. Set the oxygen flow rate to 5 L/min.

4. Open the $N_2O$ flow control valve to drain pressure from the system.

5. Close the $O_2$ cylinder valve, and close the flow control valves. Press the $O_2$ FLUSH button to drain oxygen pressure from the system.

6. Turn the System Power switch to STANDBY and remove AC power from the machine. Disable all circuit breakers.

7. Remove the screws securing the table top, and remove the top.

8. Remove the flowmeter housing back cover.

CAUTION: Use proper ESD protection when handling electronic circuit assemblies.

9. Remove the vapor box front cover. If the machine is equipped with a Multispec gas analyzer, remove the indicator light PCB assembly from the front cover.

10. Remove the vapor box back cover.

11. Remove the screws holding the angled front plate at the top of the flowmeter shield(s), and remove the plate.

    On earlier machines these screws are accessible from the rear of the flowmeter housing. On later machines the angled front plate is secured with button head screws through the front of the plate.

12. Remove the oxygen flow control knob (if required for removal of the knob guard).

13. Remove the two screws securing the knob guard, and remove the knob guard. (On earlier machines with a bar type knob guard, the center instruction channel must be removed. The screws are accessible from inside the flowmeter housing.)

14. Remove the flowmeter shield.

## INSTALLATION PROCEDURE (continued)

15. Install the high pressure gauge in the hole of the gauge channel and secure it with two 10-32 kep nuts. See Figure 1.

16. Install a gauge cover on the $O_2$-He cylinder gauge. (Earlier machines only.)

17. For earlier 2-gas machines with a three-piece flowmeter channel arrangement, install the channel assembly using 8-32 x ¼ in. cap screws and #8 lock washers (older machines may have ¼-28 x ½ in. cap screws & ¼ in. lock washers).

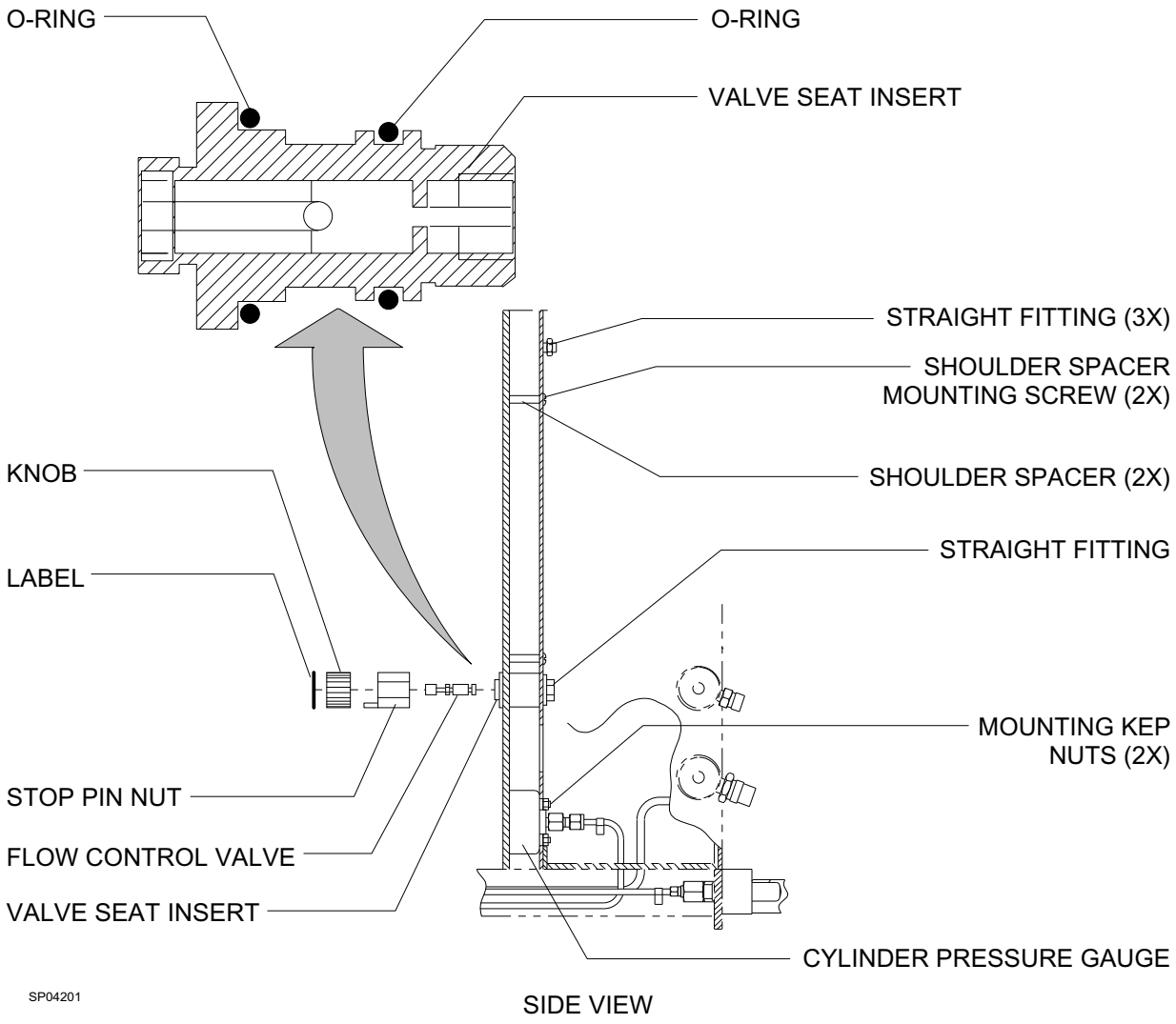



**Figure 1: $O_2$-He FLOW CONTROL VALVE AND GAUGE INSTALLATION**

**INSTALLATION PROCEDURE (continued)**

18. Attach a new instruction label to the inside bottom of the top cabinet drawer as shown in Figure 2.

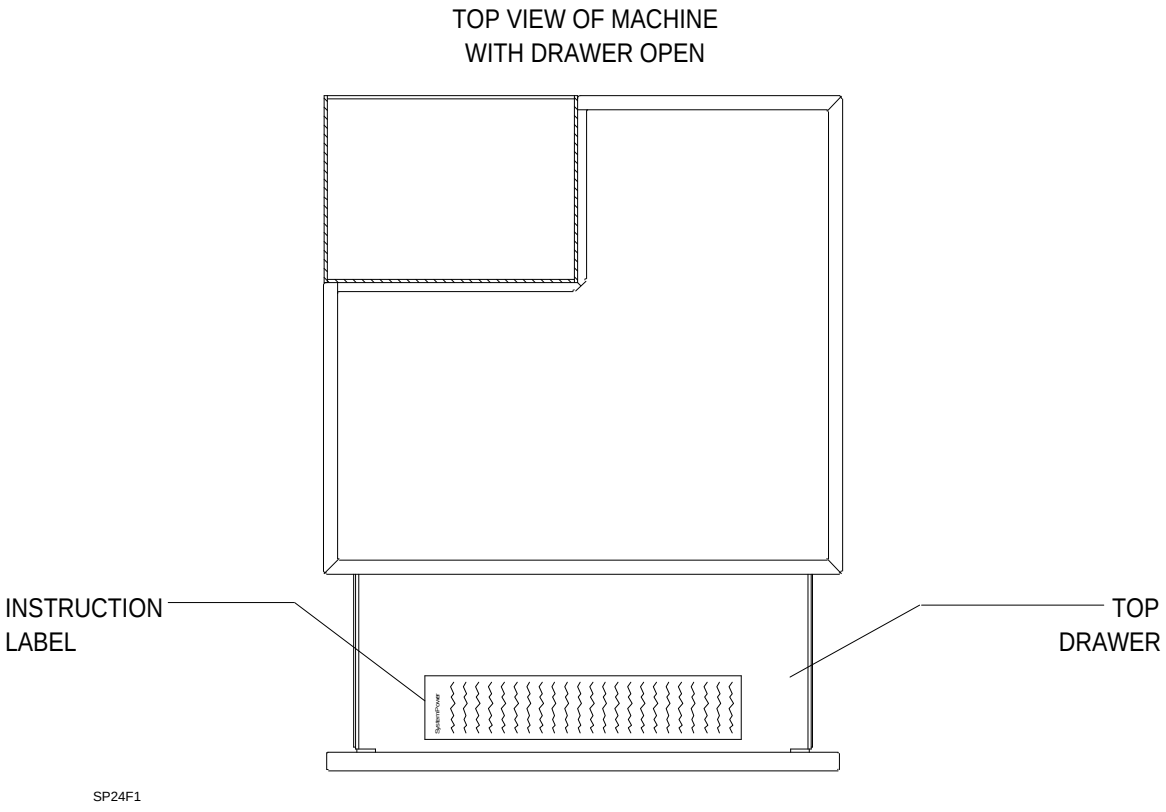



**Figure 2: NEW INSTRUCTION LABEL LOCATION**

## INSTALLATION PROCEDURE (continued)

19. Mount the cylinder support on the bottom frame rail at the back of the machine (see Figure 3) using two ¼-20 x 2½ in. hex head screws, lock washers and flat washers.

20. Mount the $O_2$-He yoke and spacer block (if required) on the upper frame rail of the machine as shown in Figure 3. Use two 5/16-24 x 1¾ in. socket head screws and lock washers. Ensure that the yoke has a "$O_2$-He" label.

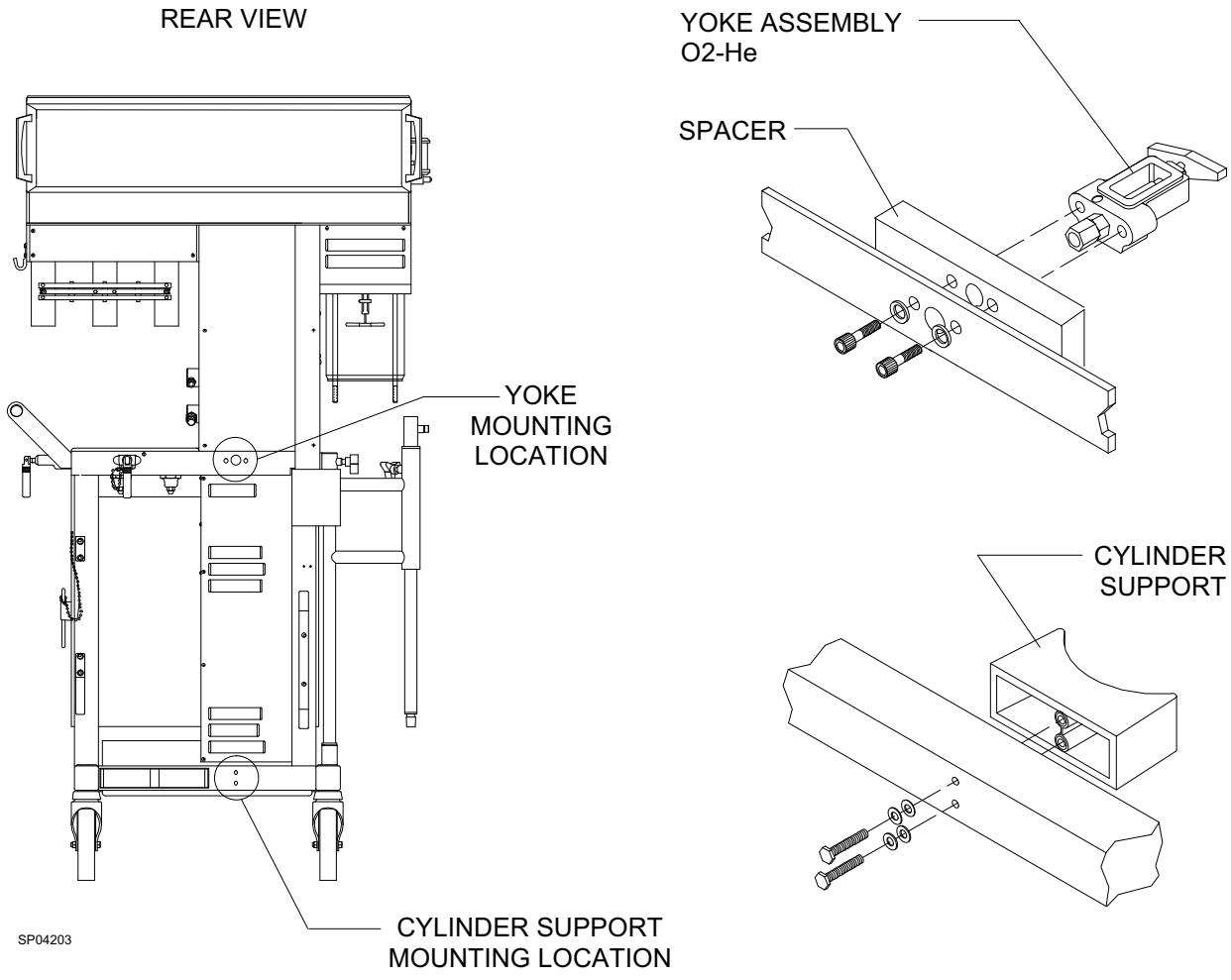



**Figure 3: $O_2$-He YOKE AND CYLINDER SUPPORT MOUNTING LOCATIONS**

## INSTALLATION PROCEDURE (continued)

21. Position the $O_2$-He cylinder pressure regulator assembly as shown in Figure 4, with the Inlet marking toward the front of the machine.

22. Install two 10-32 x ½ in. set screws in the regulator mounting bracket and tighten them.

23. Connect a 3/16 in. dia. (P/N 4104215) pre-bent copper tube between the $O_2$-He cylinder yoke and the inlet fitting (marked "IN") on the $O_2$-He cylinder regulator.

24. Ensure that the tubing and ferrules are inserted correctly, and tighten the fittings securely. Install a "$O_2$-He" label on each end of this tube.

25. Connect a 3/16 in. dia. (P/N 4104214) pre-bent copper tube between the $O_2$-He cylinder gauge that was previously installed, and the port marked "HP" on the $O_2$-He cylinder regulator. See Figure 4. Ensure that the tubing is inserted correctly, and tighten the fittings securely. Install a "$O_2$-He" label on each end of this tube.

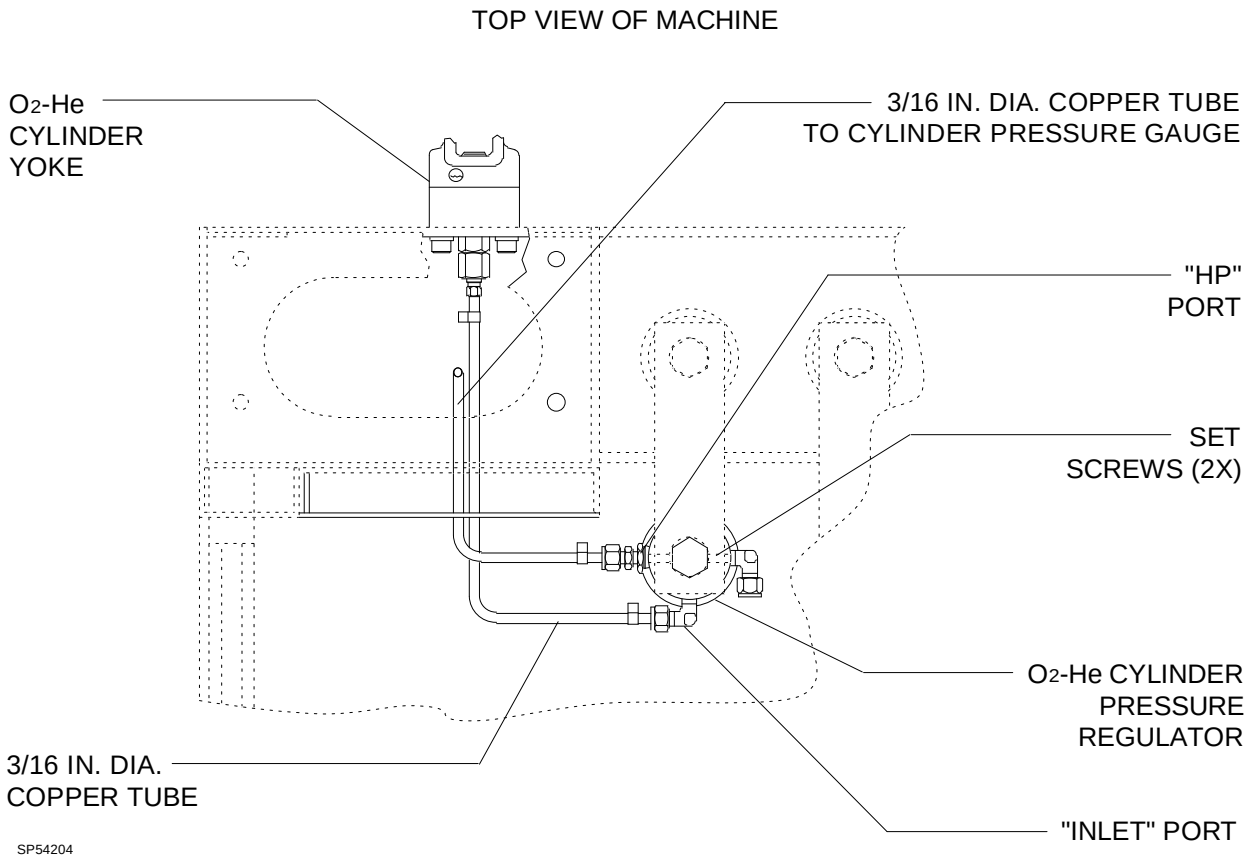



**Figure 4: $O_2$-He CYLINDER REGULATOR MOUNTING AND H.P. CONNECTIONS**

## INSTALLATION PROCEDURE (continued)

26. Remove the manifold assembly connected to the $O_2$ and $N_2O$ outlets at the top of the flowmeters.

27. Install a ¼ in.dia. "U" tube (P/N 4110835-003) from the bottom left to the top right fittings on the $O_2$-He flowmeter channel. Tighten the ferrule fittings securely and install a "$O_2$-He" label to each end of the tube (ref. Figure 10).

28. Install a ¼ in.dia. "L" tube (P/N 4110837-004) between a 4-way fitting (P/N 4102772) and the $N_2O$ flowmeter outlet as shown in Figure 5. Do not tighten the fittings. Install a $N_2O$ label on each end of this tube.

29. Install a ¼ in.dia. "L" tube (P/N 4110837-004) between the 4-way fitting and the $O_2$ flowmeter outlet as shown in Figure 5. Do not tighten the fittings. Install a $O_2$ label on each end of this tube.

30. Install as ¼ in.dia. straight tube (P/N 4110834-004) between the 4-way fitting and the $O_2$-He flowmeter outlet as shown in Figure 5. Install a "$O_2$-He" label on this tube. Tighten these connections and all those that were made in the previous two steps.

31. Install a ¼ in.dia. (P/N 4104204) pre-bent copper tube between the remaining port on the 4-way fitting and the vapor block inlet. Tighten the fittings and install a "MIX" label on each end of this tube. A top view of the manifold arrangement is shown in Figure 5.

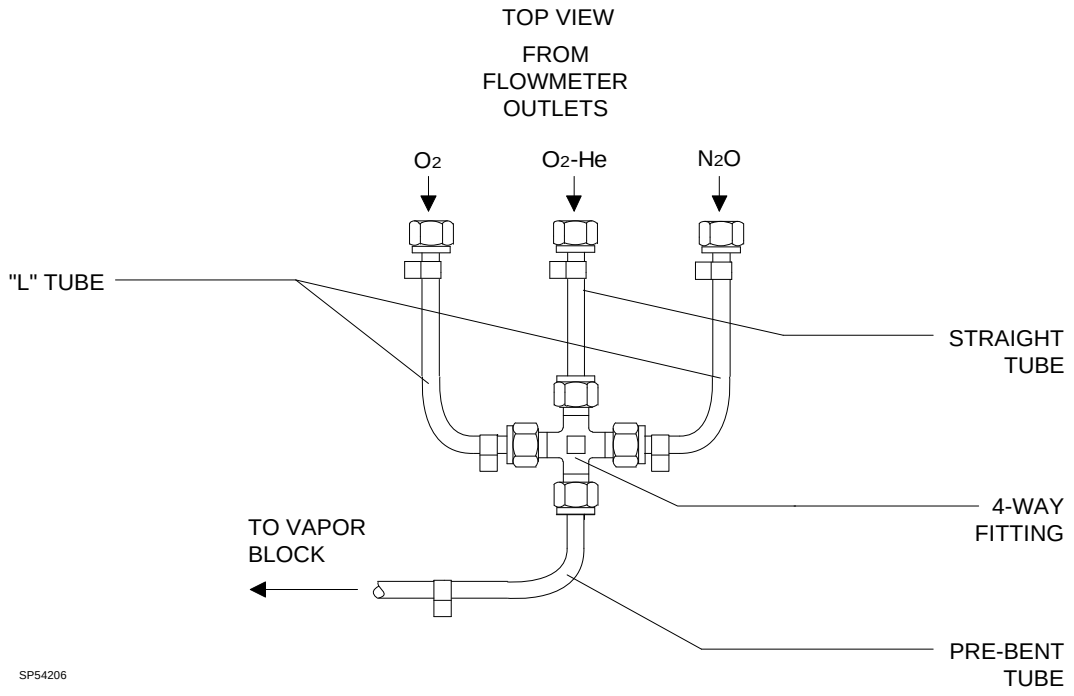



**Figure 5: THREE-GAS MANIFOLD ASSEMBLY**

## INSTALLATION PROCEDURE (continued)

NOTE: Perform the next step if machine is configured with the 30 PSI switch connected to the $N_2O$ OFPD.

If the 30 PSI switch is not attached to the $N_2O$ OFPD, skip to Step 48.

32. Remove the three wires connected to the 30 PSI switch, and remove the switch assembly by disconnecting the fittings indicated in Figure 6.

NOTE: Skip the next step if machine is configured with a 4-way fitting.

33. Remove the 3-way fitting and restrictor assembly by disconnecting the fitting at the $O_2$ flowmeter inlet. Carefully disconnect the flex tubing connections.

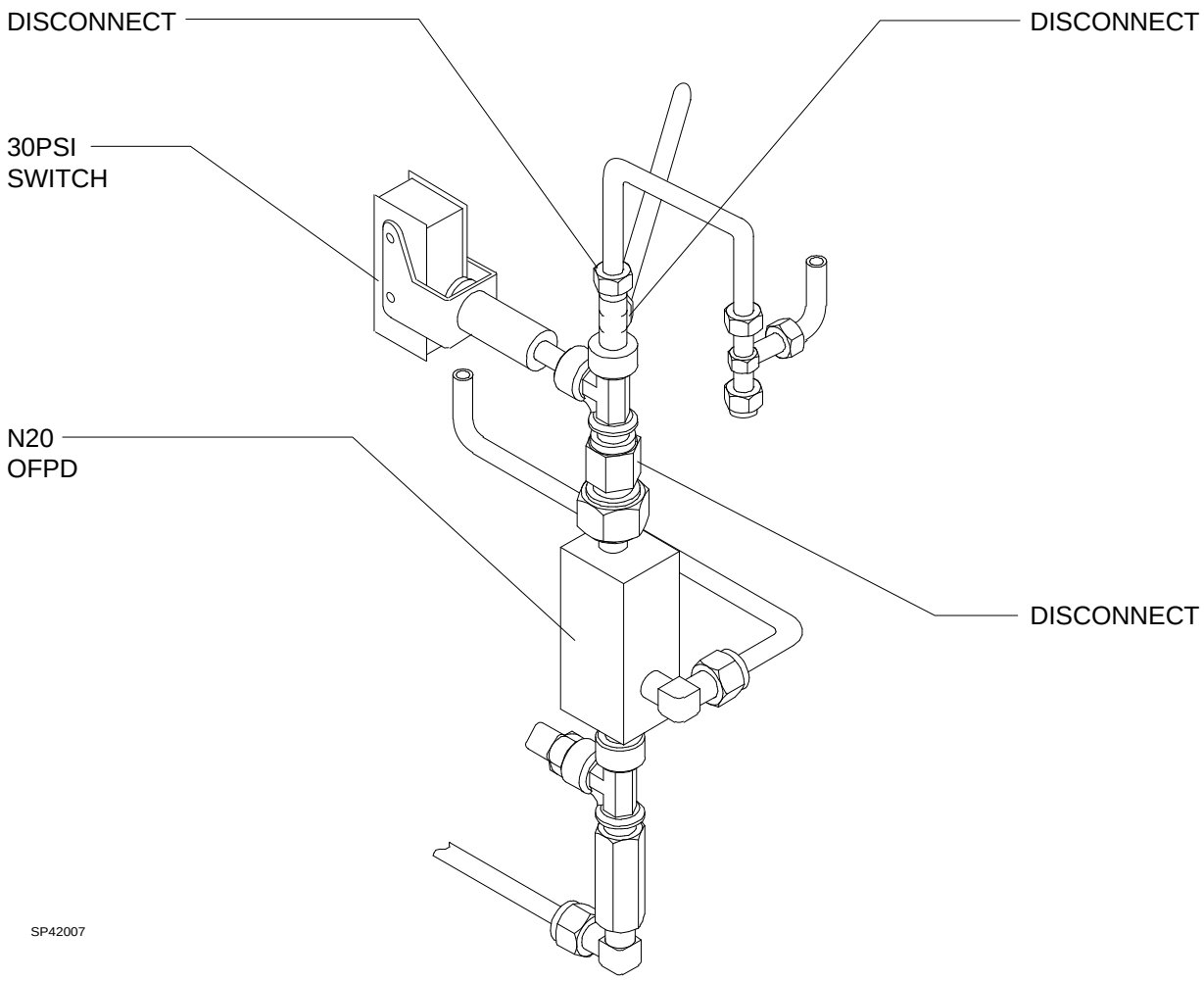



**Figure 6: 30 PSI SWITCH REMOVAL**

## INSTALLATION PROCEDURE (continued)

NOTE: Skip the next four steps if the kit includes a new switch assembly.

34. Remove the 30 PSI switch from the switch assembly that was removed in Step 39.

35. Remove any debris from the threads of the 30 PSI switch.

36. Apply a drop of Loctite #545 to the threads of the 30 PSI switch and install a female ⅛ in. elbow (P/N 4104774) onto the switch oriented as shown in Figure 7.

37. Apply a drop of Loctite #271 (red) to the threads of tee fitting (P/N 4109407). Install the tee fitting in the elbow, with the side port of the tee fitting positioned 60° past the switch as shown in Figure 7.

38. Apply a drop of Loctite #271 (red) to the threads of ⅛ MPT x 1/16 hose barb adapter fitting (P/N 4111771), and install the adapter in a DISS connector. See Figure 8.

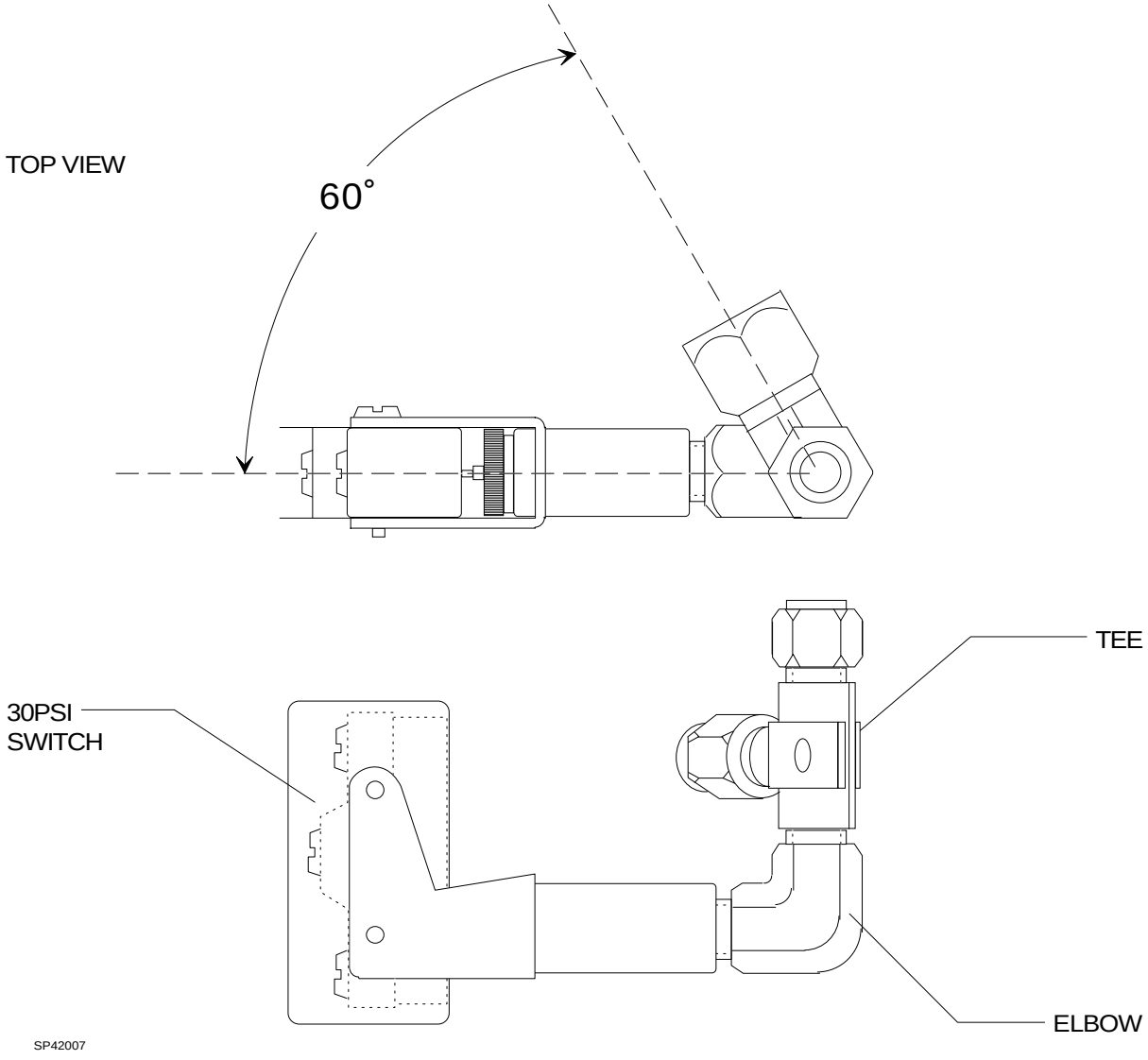



**Figure 7: 30 PSI SWITCH ASSEMBLY DETAILS**

## INSTALLATION PROCEDURE (continued)

39. Attach the DISS connector assembly to the $N_2O$ OFPD. DO NOT apply Loctite to this connection. See Figure 8.

40. If the wiring was previously removed from the 30 PSI switch, connect the wires to the switch as follows:

    Orange to COM
    Brown to N.O.
    White/Orange to N.C.

41. If the 3-way fitting was previously removed, install a new 4-way fitting and restrictor assembly (see Figure 8) by connecting its lower tube to the $O_2$ flowmeter inlet. Install a $O_2$ label at each end of the copper tube.

42. Reinstall the 30 PSI switch assembly (if previously removed) by joining the upper tube of the 4-way fitting to the tee fitting on the switch assembly.

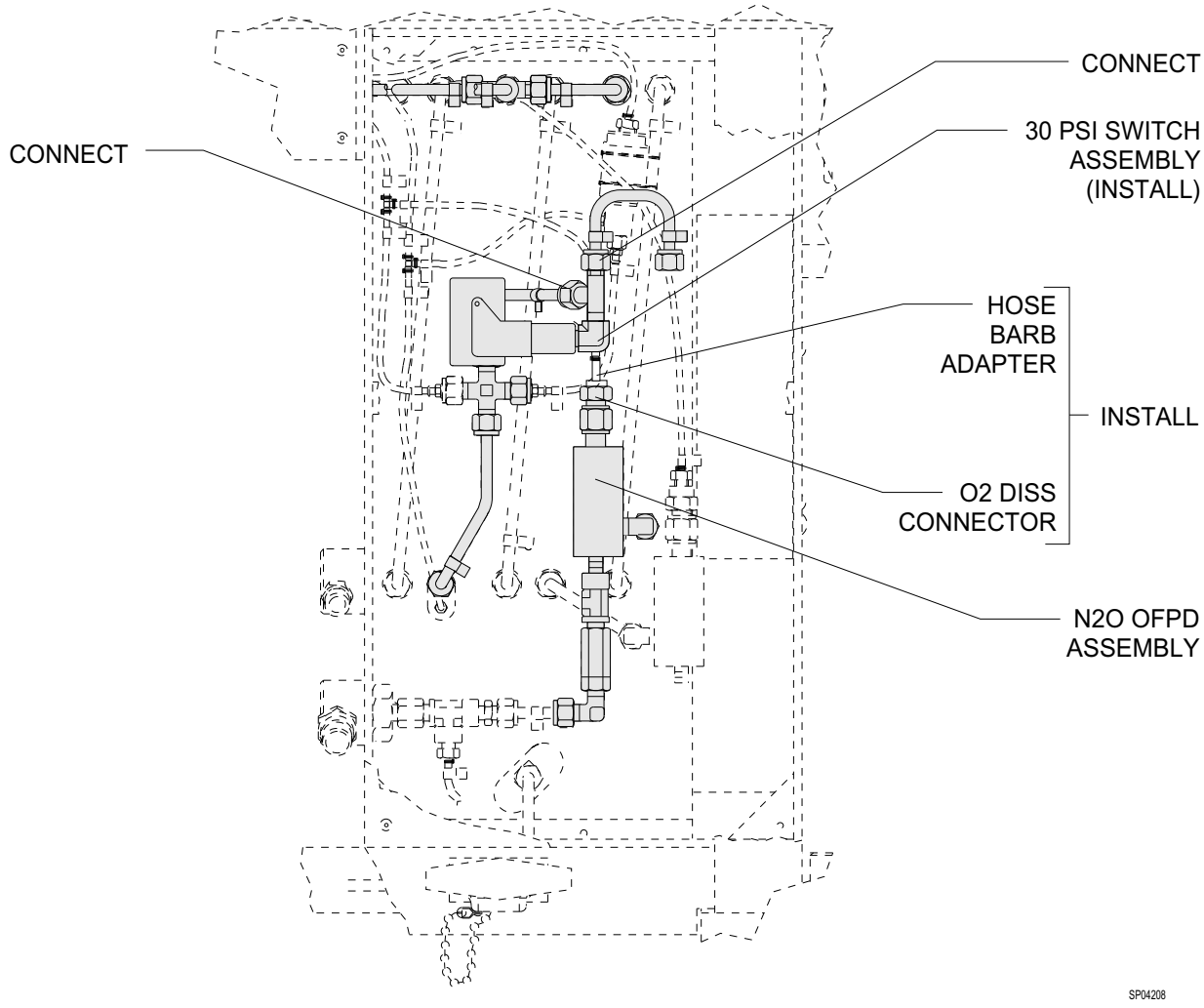



**Figure 8: 30 PSI SWITCH INSTALLATION AND OFPD DETAILS**

## INSTALLATION PROCEDURE (continued)

43. Join the upper tube of the $O_2$ pressure switch assembly (if previously removed) to the tee fitting connected to the system power switch assembly. Tighten the fittings.

44. Connect a ¼ in.dia.(P/N 4110837-015) "L" tube to the $O_2$-He cylinder pressure regulator as shown in Figure 9. Install a "$O_2$-He" label on each end of this tube.

45. Connect the other end of the "L" tube to a ¼ in. tee fitting (P/N 4108636), and install a plug in the side port of the tee fitting.

46. Connect the short end of a ¼ in.dia. (P/N 4109512) pre-bent tube to the remaining port on the tee fitting as shown in Figure 9. Install a "$O_2$-He" label on each end of this tube.

47. Connect a ¼ in.dia. (P/N 4110836-004) "S" tube to the $O_2$-He flowmeter inlet. See Figure 10. Install a "$O_2$-He" label on each end of this tube.

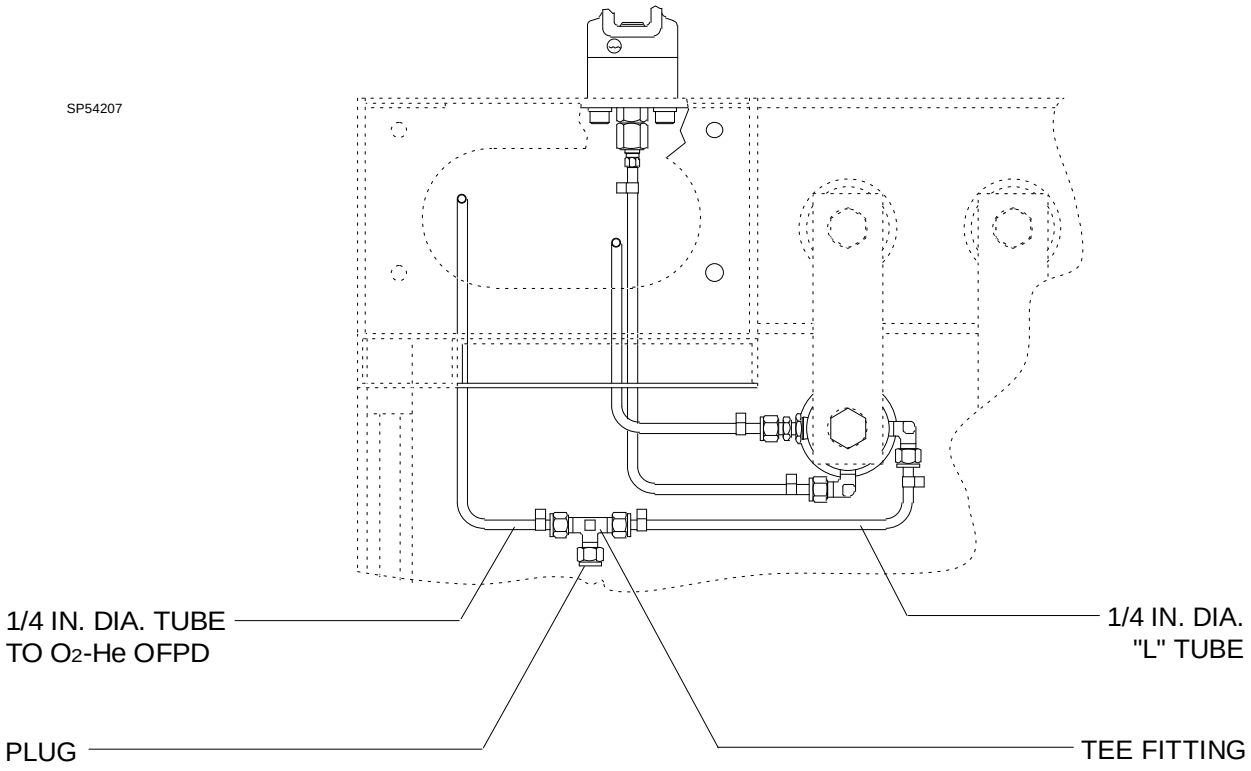



**Figure 9: $O_2$-He CYLINDER REGULATOR L.P. CONNECTIONS**

**INSTALLATION PROCEDURE (continued)**

48. Position the $O_2$-He OFPD assembly in the flowmeter housing, and connect the other end of the "S" tube to the side fitting on the OFPD.

49. Connect the tube from the $O_2$-He cylinder pressure regulator to the bottom fitting of the $O_2$-He OFPD as shown in Figure 10.

50. Attach the minimum flow cutoff valve to the $N_2O$ flowmeter "U" tube with two tie straps as shown in Figure 10.

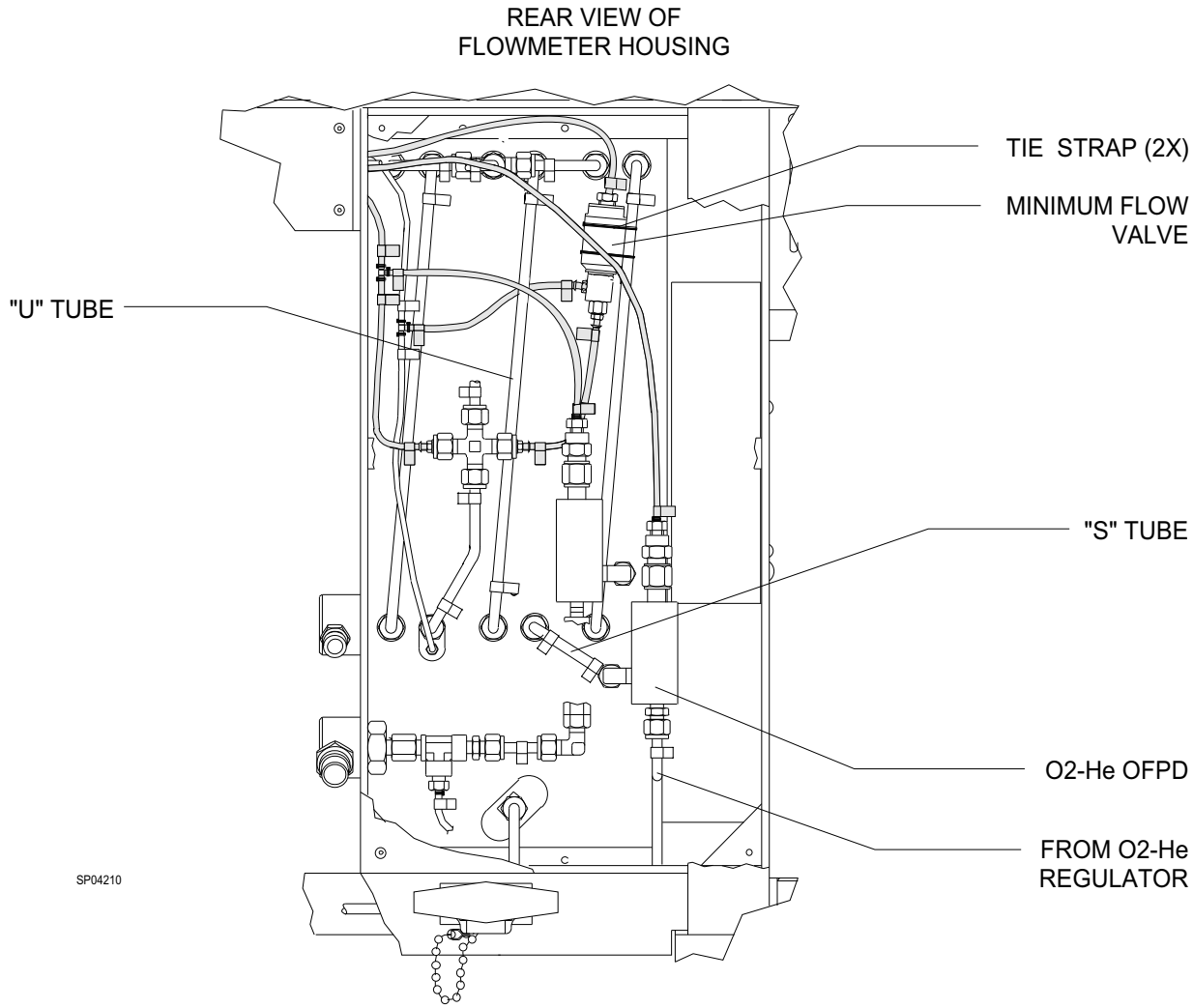



**Figure 10: $O_2$-He OFPD AND MINIMUM FLOW VALVE INSTALLATION**

## INSTALLATION PROCEDURE (continued)

51. Mount the gas selector valve assembly to the floor of the vapor box, oriented as shown in Figure 11, with two 10-32 x 5/16 in. socket head screws, lock washers and flat washers.

52. Skip this step if the ORMC has an electrical switch:

    Connect a 32 ½ in. length of flex tubing to the front port on the gas selector assembly and secure it with a press-on clamp. Connect the other end of the tubing to the top hose barb on the minimum flow cut out valve, and secure it with a press-on clamp. Install a $O_2$ label on each end of this tube.

53. Connect a 10½ in. length of flex tubing to the side port of the front valve on the gas selector, and secure it with a press-on clamp. Connect the other end of the tubing to a nylon tee fitting and secure it with a tie strap. Install a $O_2$ label on each end of this tube as shown in Figure 11.

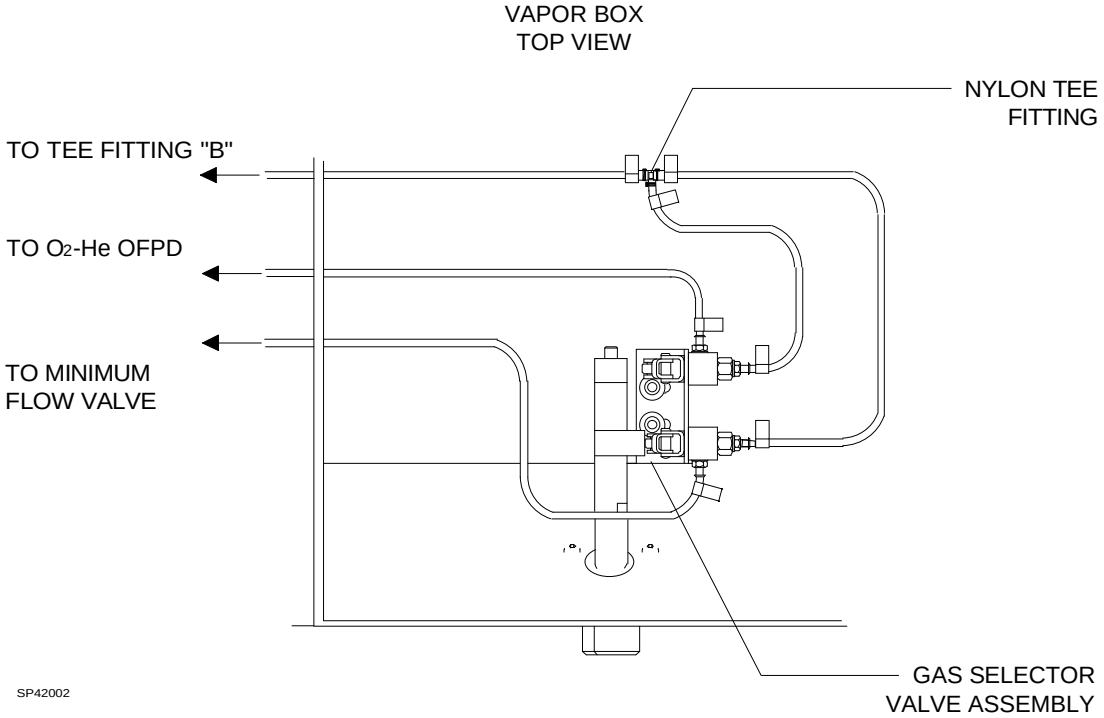



**Figure 11: GAS SELECT VALVE AND CONNECTIONS**

## INSTALLATION PROCEDURE (continued)

NOTE: Perform the next three steps if the ORMC assembly has an electrical switch. Otherwise, skip to Step 58.

54. Attach the pressure switch assembly to the copper tubing in the vapor box with two tie straps as shown in Figure 12.

55. Join the wire harness connectors from the alarm channel and the ORMC to the pressure switch assembly as shown in Figure 12.

56. Connect a 13½ in. length of flex tubing to the left side port of the pressure switch in the vapor box, and secure it with a press-on clamp. Connect the other end of the tubing to the top hose barb on the minimum flow valve, and secure it with a press-on clamp. Install a $O_2$ label at each end of this tube.

57. Install a 16 in. length of flex tubing between the right side port of the pressure switch and the front port on the gas selector assembly. Secure each end of the tubing with a press-on clamp. Install a $O_2$ label on each end of this tube as shown in Figure 12.

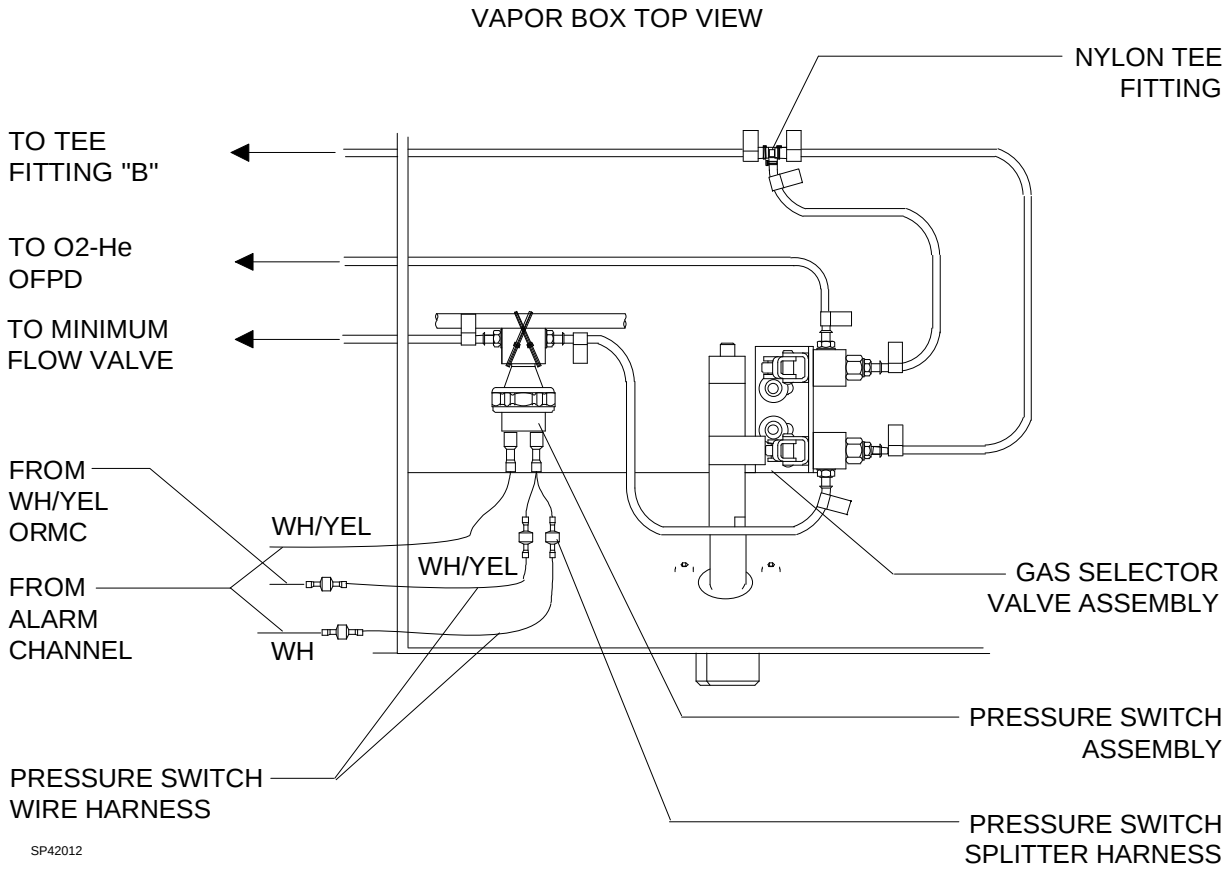



**Figure 12: GAS SELECT VALVE AND PRESSURE SWITCH CONNECTIONS**

**INSTALLATION PROCEDURE (continued)**

58. Connect an 8 in. length of flex tubing from the side port of the rear valve on the gas selector and secure it with a press-on clamp. Connect the other end of the tubing to the center port of the nylon tee fitting, and secure it with a tie strap. Install a $O_2$ label on each end of this tube.

59. Connect a 24 in. length of flex tubing from the rear port on the gas selector assembly to the hose barb on the top of the $O_2$-He OFPD in the flowmeter housing. See Figures 11, 12 and 13. Secure both ends with a press-on clamp. Install a $O_2$ label on each end of this tube.

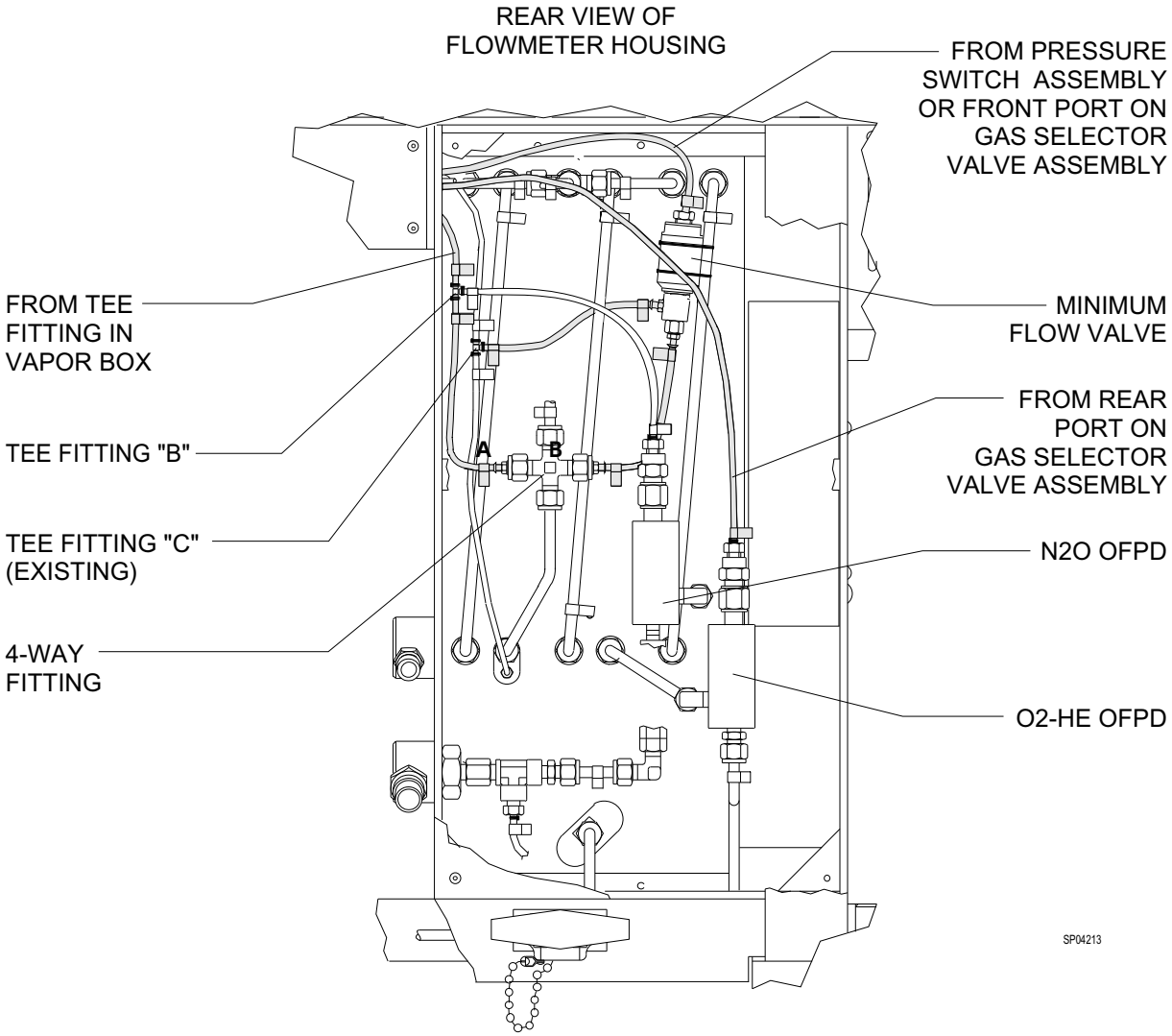



**Figure 13: FLEX TUBING CONNECTIONS**

## INSTALLATION PROCEDURE (continued)

60. Connect a 12 in. length of flex tubing from the remaining port of the nylon tee fitting in the vapor box to the top of nylon tee fitting "B" in the flowmeter housing. See Figure 13. Secure each end of the tube with a tie strap, and install a $O_2$ label at each end of the tube.

61. Connect a 5 in. length of flex tubing to the bottom of nylon tee fitting "B" and secure it with a tie strap. Connect the other end of the tubing to side port "A" on the 4-way fitting. See Figure 13. Secure this end with a press-on clamp, and install a $O_2$ label at each end of the tube.

62. Connect an 8 in. length of flex tubing to the top port on the $N_2O$ OFPD and secure it with a press-on clamp. Connect the other end of the tubing to the remaining port on nylon tee fitting "B" and secure it with a tie strap. Install a $O_2$ label at each end of the tube.

63. Connect an 8 in. length of flex tubing from side port "B" on the 4-way fitting to the bottom port of the minimum flow valve, and secure each connection with a press-on clamp. Install a $O_2$ label at each end of the tube. See Figure 13.

64. Connect a 10 in. length of flex tubing to the side port of nylon tee fitting "C", and secure it with a tie strap. Connect the other end of the tubing to the side port of the minimum flow valve, and secure it with a press-on clamp. Install a $O_2$ label on each end of this tube.

65. Inspect the existing flex tubing between the $O_2$ flow control valve and the bottom port on nylon tee fitting "C", and ensure that each end is properly secured.

66. Inspect the existing flex tubing between the top port on nylon tee fitting "C" and the ORMC/ORM assembly. Ensure that each end is properly secured.

67. Determine the proper front vapor box panel(s) required: (Multispec option and/or single or double front cover). If the machine is equipped with a Multispec analyzer, assemble the indicator light PCB assembly to the front panel using the hardware that was previously removed. See Figure 14. Ensure that the lamp windows have the arrow labels.

68. Assemble the gas selector switch cam assembly to the new vapor box front panel with two 8-32 x 3/8 in. socket head screws and lock washers. See Figure 14.

69. Install the vapor box front panel and ensure that the selector switch cams operate the gas select valves correctly.

70. Open one cylinder valve each of Oxygen, Nitrous Oxide, and $O_2$-He.

71. Enable all circuit breakers and connect AC power to the machine. Turn the System Power switch to ON.

**INSTALLATION PROCEDURE (continued)**

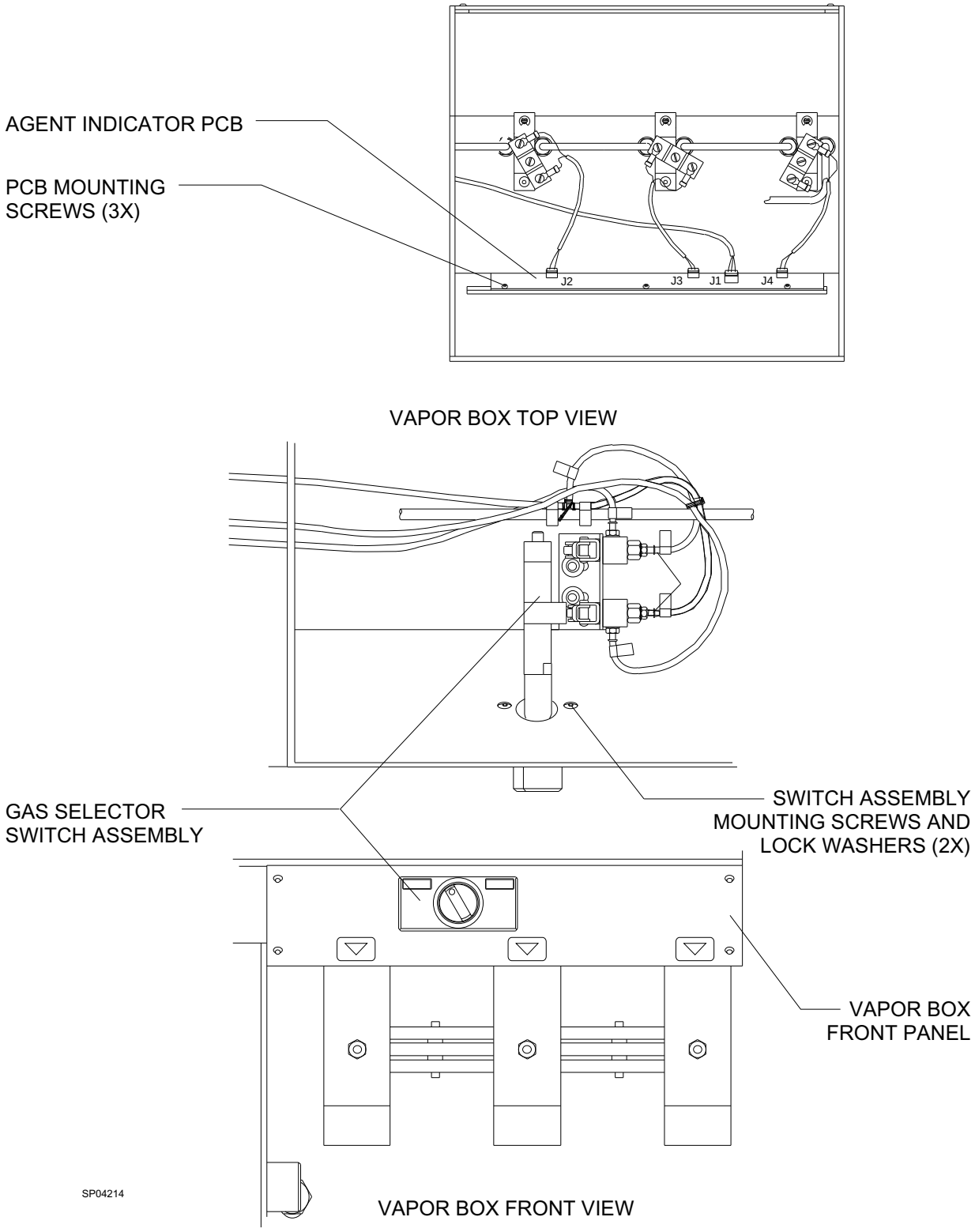



**Figure 14: GAS SELECTOR SWITCH AND AGENT INDICATOR LAMP PCB ASSEMBLY**

## INSTALLATION PROCEDURE (continued)

72. Remove the oxygen fine flowmeter tube from its channel by turning the upper flow tube retainer counter-clockwise with a cut down 5/32 allen key.

73. Open the oxygen flow control valve fully counter-clockwise for several seconds to flush out any debris in the new piping system.

74. Carefully reinstall the flowmeter tube and ensure that all gaskets and O-rings are properly installed, and that the tube is oriented with its markings facing forward.

75. Install the $O_2$-He label (P/N 4110951) on the knob.

76. Open the $O_2$-He flow control valve fully counter-clockwise for several seconds to flush out any debris in the new piping system.

77. On newer machines: Install tube connectors into the recess at the top of the $O_2$-He flowmeter channel.

78. Place a large gasket (P/N 4102724) into the top left seat of the flowmeter channel. See Figure 15.

79. Place a small gasket (P/N 4102725) into the bottom left seat of the flowmeter center channel. Install the flow tube extension (P/N 4103792) on top of the gasket, and place a large gasket on top of the extension.

80. Install the $O_2$-He flow tube (P/N 4112569-001) in the left side of the flowmeter channel. Ensure that the markings on the flow tube are facing forward, and tighten the upper flow tube retainer screw with a cut down 5/32 allen key.

CAUTION: do not over-tighten the screw as the flow tube may break.

81. Place a large gasket (P/N 4102724) in the top right flow tube seat, and a large gasket in the bottom right flow tube seats. Install the blind flowmeter tube (P/N 4103793).

82. Join the flowmeter lights PCB assembly (P/N 4107370) to the flowmeter lights wiring harness - black to pin nearest the PCB, red to other pin.

83. Slide the flowmeter lights channel (P/N 4104739) over the PCB assembly and place it over the shoulder spacers at the center of the flowmeter channel.

84. Remove the $N_2O$ fine flowmeter tube from its channel by turning the upper flow tube retainer counter-clockwise with a cut down 5/32 allen key.

85. Open the oxygen and $N_2O$ flow control valves fully counter-clockwise for several seconds to flush out any debris in the new piping system.

86. Carefully reinstall the flowmeter tube and ensure that all gaskets and O-rings are properly installed, and that the tube is oriented with its markings facing forward.

## INSTALLATION PROCEDURE (continued)

87. Install the 3-gas flowmeter shield over the flowmeter sub-assembly, and secure the cover with 2-56 x ¼ flat head screws (early machines).

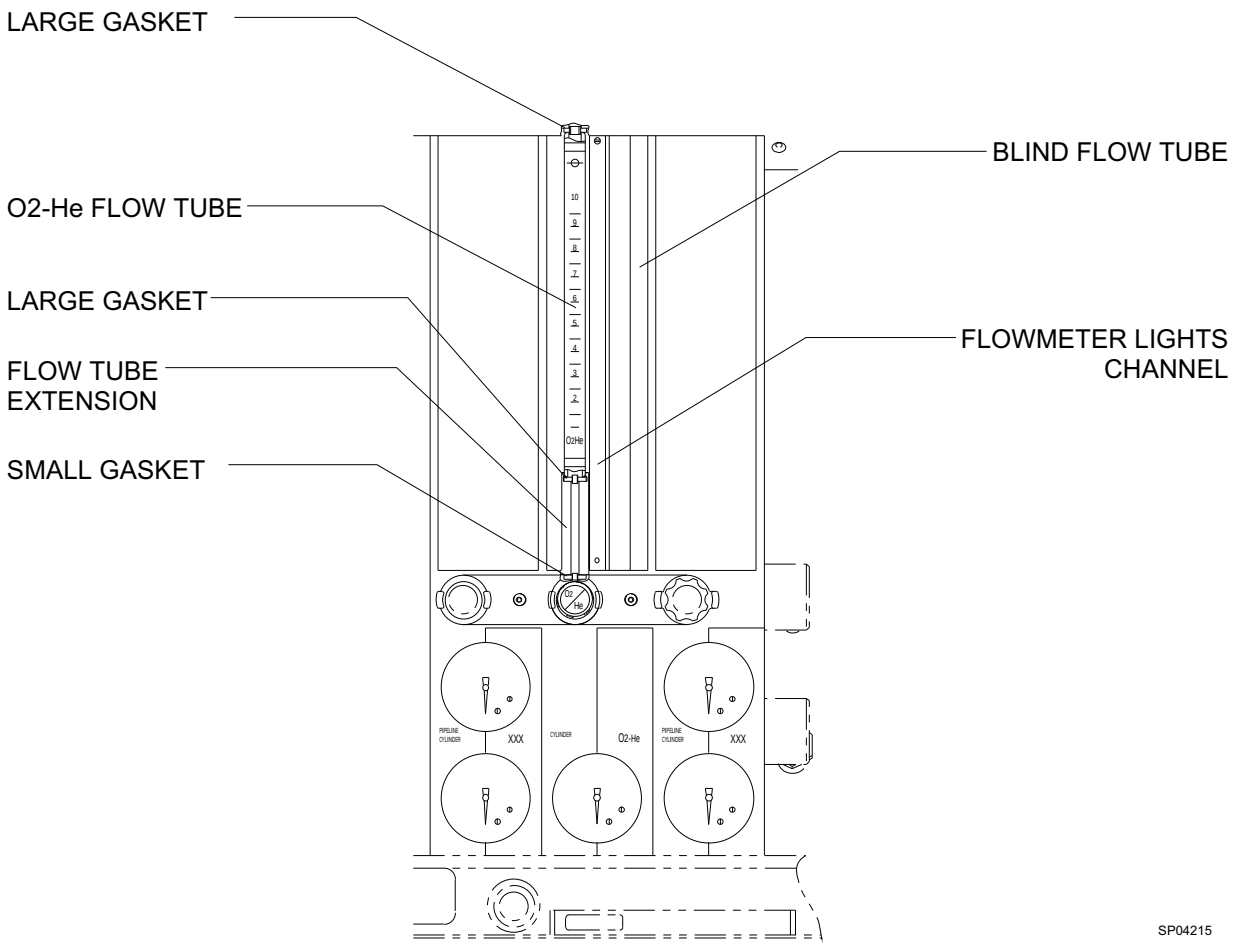
88. On later style machines, install the 3-gas knob guard and secure it with the two screws that were previously removed.

89. On later style machines, reinstall the $O_2$ flow control knob, and ensure that the mechanical stop is correctly set to coincide with the valve closure.

90. Replace the angled front plate at the top of the flowmeter shields. On earlier machines the front plate is held by two screws from the back - inside the flowmeter housing. On later machines the front plate is secured with button head screws through the front of the plate.

91. Close all cylinder valves and drain the pressure from the system.

92. Proceed to the Adjustment and Test section.




FRONT VIEW

**Figure 15: $O_2$-He FLOW TUBE INSTALLATION**

## OXYGEN SUPPLY PRESSURE ALARM ADJUSTMENT

1. Remove the plug from the $O_2$ cylinder pressure regulator output line, and connect a test gauge (#S000063) to the tee fitting.
2. Attach an oxygen cylinder to the oxygen yoke on the machine.
3. Open the oxygen cylinder valve and set the oxygen flow rate to 1 l/min.
4. Close the oxygen cylinder valve.
5. As the pressure drops, the oxygen supply pressure alarm shall activate when the pressure is between 30 and 34 psi as indicated on the test gauge.
6. If the alarm activates when the pressure is above 34 psi or below 30 psi, turn the adjustment wheel on the oxygen supply pressure switch, repeat the test and adjust as necessary to bring the set point into the correct range.
7. Close the oxygen flow control valve.
8. Allow pressure to drain from the system.
9. Close the flow control valve and turn the System Power switch to STANDBY.
10. Disconnect the test gauge and replace the plug in the tee fitting.

## $O_2$-He CIRCUIT ADJUSTMENT AND TEST

**Cylinder Pressure Regulator Adjustment**

1. Remove the plug from the tee fitting in the $O_2$-He cylinder pressure regulator output line, and connect a test gauge (#S000063) to the tee fitting.
2. Attach an $O_2$-He cylinder to the $O_2$-He yoke on the machine.
3. Connect AC power to the machine and turn the System Power switch to ON.
4. Set the Gas Select switch to the ALL GAS position.
5. Open the $O_2$ cylinder valve and set the oxygen flow rate to 4 l/min.
6. Open the $O_2$-He cylinder valve and set the $O_2$-He flow rate to 4 l/min.
7. The test gauge should indicate between 43 and 49 psi. If adjustment is needed, remove the acorn nut from the bottom of the regulator to expose the adjusting screw. Turn the screw to bring the pressure reading into the correct range. Replace the acorn nut.
8. Close the cylinder valves and allow pressure to drain from the system.
9. Close the flow control valves and turn the System Power switch to STANDBY.
10. Disconnect the test gauge and replace the plug in the tee fitting.

## $O_2$-He CIRCUIT ADJUSTMENT AND TEST (continued)

### High Pressure Leak Test

11. Open the cylinder valves and allow the gauge pressures to stabilize.

12. Close the cylinder valves and observe the cylinder pressure gauges. The pressure should not drop more than 50 psi over the next two minutes.

### Low Pressure Leak Test

13. Ensure that all flow control valves are closed.

14. Connect a 15mm connector, test gauge and B.P. bulb with a hose to the freshgas outlet, and pressurize the system to 50 cm H2O. Pinch off the hose to ensure that the B.P. bulb is not the source of any leak.

15. The pressure should not drop more than 10 cm $H_2O$ in thirty seconds.

16. Disconnect the test equipment.

### OFPD Test

17. Turn the System Power switch to ON.

18. Open the $O_2$ and the $O_2$-He cylinder valves.

19. Set the oxygen flow rate to 1.0 l/min., and the $O_2$-He flow rate to 1.0 l/min.

20. Close the $O_2$ cylinder valve. When the oxygen flow stops, the $O_2$-He flow must also drop to zero.

### Flowmeter Test

21. Open the $O_2$ cylinder valve.

22. Adjust the flow of $O_2$-He over the full range of the flowmeter. The float should move freely over its entire range.

### Oxygen Concentration Test

23. Turn the System Power switch to ON.

24. Connect a 12 inch hose to the inspiratory valve.

25. Set the Man/Auto selector to BAG.

26. Close the APL valve.

27. Occlude the bag mount.

28. Insert the sensor from a calibrated $O_2$Med into the valve dome adapter on the inspiratory valve.

29. Press the $O_2$ Flush button for 15 seconds.

30. The $O_2$Med shall read 97-100% within three minutes.

31. Set the LOCK OUT device to ALL GASES.

32. Set the $O_2$-He flow to 2 l/min.

33. The oxygen concentration shall be 72-78%.

34. Close the $O_2$-He flow control valve.

35. Set the LOCK OUT device to $O_2$+$N_2O$.

## $O_2$-He CIRCUIT ADJUSTMENT AND TEST (continued)

### ORMC Test

36. Fully open the $N_2O$ flow control valve. Slowly open and close the $O_2$ flow control valve, and observe that the ORMC is controlling the flow of nitrous oxide. There should be no ORMC alarm* with the Gas Select switch in the ALL GAS position. If the machine is equipped with a central alarm display, verify that the ORM ALARM OFF message is displayed.

37. Turn the Gas Select switch to $O_2$ + $N_2O$. Fully open the $N_2O$ flow control valve. Slowly open and close the $O_2$ flow control valve, and observe that the ORMC is controlling the flow of nitrous oxide. The ORMC alarm* should function correctly with the Gas Select switch in the $O_2$ + $N_2O$ position.

* The alarm circuit test is not applicable on newer machines without the $O_2/N_2O$ ratio lamp.

### Gas Select Switch Test

38. Open the $N_2O$ cylinder valve.

39. With the switch in the ALL GAS position,open all of the flow control valves and observe that all gases are able to flow.

40. Turn the Gas Select switch to $O_2$ + $N_2O$. The flow of $O_2$-He should stop.

41. Close all of the flow control valves. There should be a minimum oxygen flow.

42. Turn the Gas Select switch to ALL GAS. The minimum oxygen flow should stop.

### Re-assembly

43. Close the cylinder valves and the flow control valves, and turn the System Power switch to STANDBY.

44. Ensure that the "off stop" is correctly set on the flow control valves, and install knob labels as needed.

45. Replace the table top on the machine.

46. Replace the vapor box back cover and the flowmeter housing back cover.

47. Perform a complete PMS on the machine.

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Part Number: SP00042
Rev: B
Date: October 31, 1996